

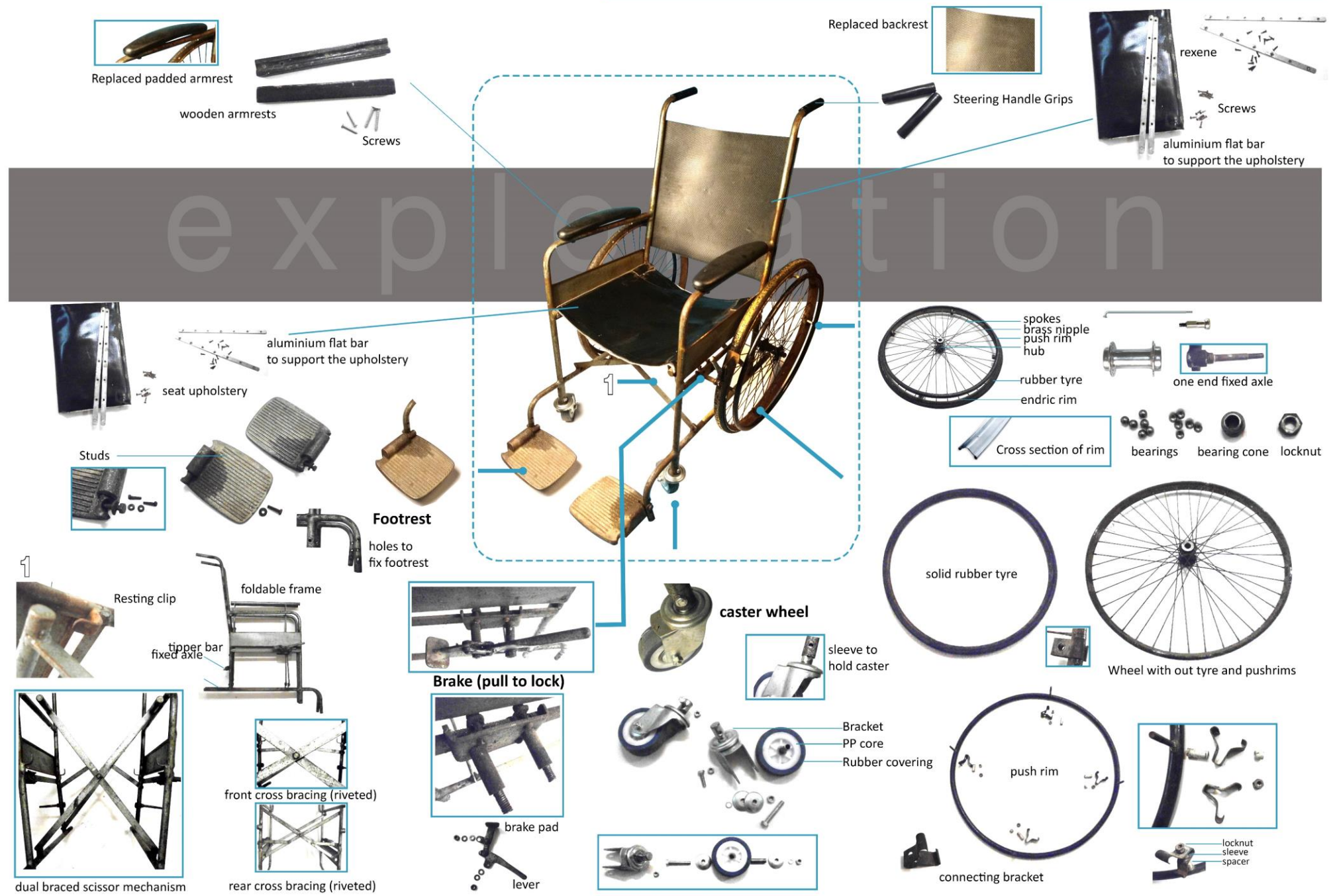
REDESIGNING OF WHEELCHAIR FOR INDIAN CONTEXT

A LIGHTWEIGHT MOBILITY FOR PHYSICALLY CHALLENGED PERSON

Disassembling wheelchair



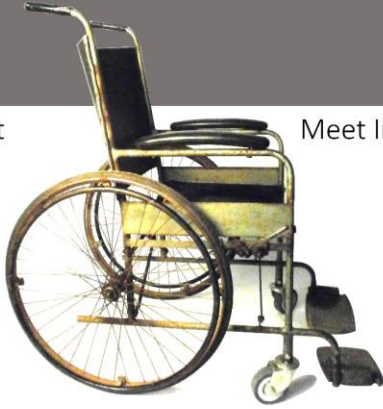
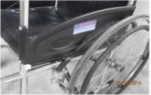
Redesigning of Wheelchair for Indian Context



Product comparison



Redesigning of Wheelchair for Indian Context

Product Image & Manufacturers	Carbon steel grade -304 :good resistance to corrosion :good malleability and weldability		
	IDC department 	Meet Importers  M.R.P.=5800 Rs.	Mahavir Surgicals  M.R.P.=6800 Rs.
Components & Specifications			
Castor wheels		3" Bracket type With PP core	
Pushrims/Handrims		painted tubular section	
Footplates		Foldable aluminium stud	
Upholstery		Black Rexene	
Wheel locks		Pull to lock MS assembly Powder coated MS plate	
Side panels		Dual Crossbraced Flat Bars (Riveted) MS Powder coated	
Folding Assembly		Padded arms Wrap-around Nylon strap	
Frame		N/A	
Armrests		Endric Type Bicycle Rims MS tube without grip 24" Molded solid Rubber	
Steering Grip			
Safety Features			
Wheels			
Tippers			
Tyres			

Examples:



Redesigning of Wheelchair for Indian Context

Which Are **Capable**
of Carrying Much More than Their **Own Weight**

3 Skateboard

: plywood has omnidirectional strength due to its layered structure
plywood divides rider's weight between front and rear wheels.



:A Skateboard is a type of sports equipment used primarily for the activity of skateboarding.
:Skateboard weighs 1.8 kg

6 Hammock

: tensile strength
due to flexible webbing strap-cords.



:A hammock is a sling made of fabric, rope, or netting, suspended between two points, used for swinging or resting.
:The entire assembly of One hammock weighs 400-600 grams.

9 Cup Nest of Sparrow (Gauraiya)

: interlocking in straws
nest weave density
shape of the nest



:House sparrow (weight -30-40 grams)
:Sparrow's egg (weight -3-4 grams).

1 Cobweb

:clustering and radial connectivity
tensile strength of segmented silk



:One weave of Cobweb silk can hold the Weight of One House Spider. (weight 2 to 3 grams)
:It is up to 6 times stronger than high-grade steel per weight.

4 Mushroom

:cantilevered UDL of cap
concentrated at free end.



:The weight of the cap of a mushroom is 2-3 times heavier than the stem or stalk.

7 Parachute

:principle of 'air resistance'
zero-porosity fabrics that are meant to slow down the fall of people.
(linen, canvas, or nylon)



:The entire assembly of One Parachute weighs 14 kg-20 kg.
:It can carry one person (average weight -65kg).

10 Dung beetles (also known as gubrella in India)

: Rolling
due to continuous rolling the dung reforms into spherical shape.



:A dung beetle can bury dung 250 times heavier than itself in one night.

2 Tiger

:strong physical characteristics
the bones of the tiger's front legs are strong and dense to support the large musculature.



the bones in each of the tiger's feet are tightly connected by ligaments enabling them to buffer the impact of landing from running, pouncing and leaping.

:A tiger can carry something 550kg, twice its own body weight.

5 Director's chair

:scissors action (foldability)
braced frame gives more strength to it



:A director's chair is a lightweight chair, weighs 4-5 kg.
It is sufficient for 100-120 kg live load.

8 Seesaw swing

: A lever that hinges on a pivot point called a fulcrum.
equilibrium mechanics



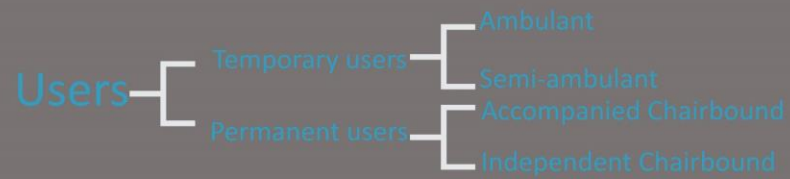
:A see saw is a kind of swing, weighs 40-60kg.
It can hold 100-150 kg live load.

11 Bicycles

:diamond shape frame
frame divides rider's weight between front and back wheels.



:Bicycle are used for transportation of peoples.
:The entire assembly of Bicycle weighs 18 kg -20kg.
:It is suitable for 1-2 persons (average weight -65kg).



Wheelchair: Assistance to Disabled Persons

Man

Physiological

Malformation
Posture issues
Acceptance

Comfort

Seat
Back Rest
Arm Rest
Foot Rest

Convenience

Ingress/Egress
Transferability
Relaxing Posture
Handling
Propelling
Maintenance

Social

Dignity

Aesthetics

Look

Machine

Dimensions

Seat depth
Seat Width
Armrest Width
Armrest Height
Backrest Height

Weight

Light in Weight

Stability

Performance
Adjustment

Strength

Load bearing capacity

Materials

Durability

Process Of Manufacturing

Environment

Built Infrastructure

Parks/Gardens
Railway Station
Multiplex
Shopping mall

Indoor Places

Bathroom
Using WC
Going to Bed
Using Table

Outdoor Places

Elevators
Staircase
Ramp
pathways



H14-IDC --- H14-Mess --- H14-IIT Hospital --- IDC-SJM SOM --- H14-H15 --- SOM-IIT Hospital --- H15-Central library

Wheel Chair is a mobility device designed for shifting patients, moving physically challenged people from one place to another with the help of attendee or by means of self-propelling.

The wheel chair is divided into two categories-
Battery powered wheelchairs

Manual wheelchairs

:Foldable

:Rigid or non-foldable

I had conducted two weeks user study within the IIT campus.

:For better learning and experience I have used wheelchair in my day to day life.

:To get a hands on feelings it was a great idea.

:By this I could understand the problems very well.



:hectic in holding push rims (due to distributed force applied by hands)



:Stress in hand while steering the wheelchair due to this kind of handle

: stress injuries



:problem in reaching the table and non adjustable height of table for ease of work which increases repetitive stress injuries like wrist, back and shoulder injuries.



:Height of side panels and arm rest creates obstruction while shifting the patient from wheel chair to another transportation medium.



:width of wheelchair create trouble while accessing elevator



Voice of users:

:Light in Weight.

Cost effective.

:Highly visible frame colour.

:Correlation between disability and poverty.

:Facing problem while defecating.

:No ramp for wheelchair in Best Buses.

:Unfortunately, India is not disabled friendly Country.

:There is difficulty in shifting the patient from wheel chair to auto rickshaw and other vehicles.

:Dignity of the user-Aesthetically it should not look like hospital equipment.

:NGO and Govt distributed wheelchairs are not up to standards.

:many of them dont know-is it a good or bad design.



Foot rest

It is too low in the current wheelchair, it hits door thresholds when traversing. (Image 1)

Footrest contact occurs most often during starting to go up a ramp or when transitioning between the ramp and flat ground when descending. (Image 2) (Image 3)

The danger lies in the fact that a moving wheelchair can tip forward if the footrests suddenly hit an obstacle.

Seat Pan

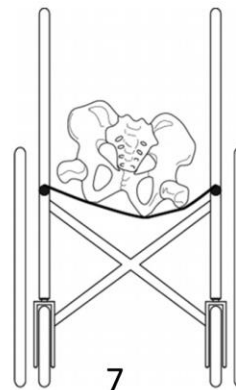
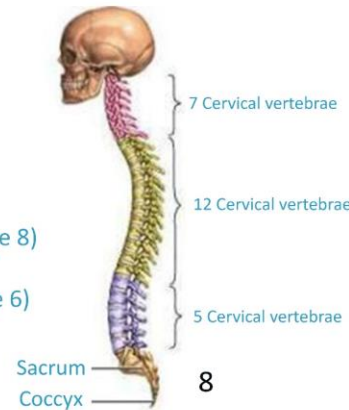
One of the most common problems with wheelchairs can be attributed to sling seat upholstery. (Figure 7)

Backrest

The height of the backrest does not fulfill the lumbar support.

Due to the long use of wheelchair this creates the pain near the sacrum. (Image 8)

Sitting with a backrest with short height can lead to postural instability. (Image 6)

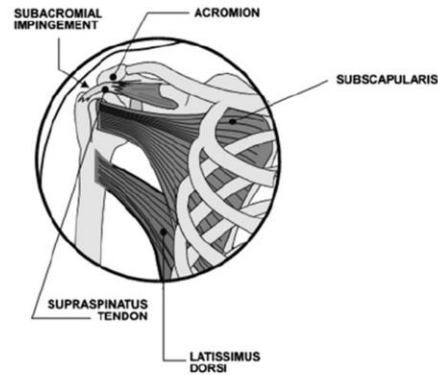


Arm rest

Armrests serve a valuable postural support role for users. They have different body structure.

The armrests are too high so it forces the user to elevate his/her shoulders, leading to discomfort. (Image 4, 5)

Due to the lack of adjustability, the armrest does not allow the user to go underneath the table or desk. (Image 6)



Armrest Height

Resting of arm is obstructed by a armrest This will result in postural instability. Due to this the armrest force the shoulder towards up that generates the stress to shoulders. (Image 9)



Backrest Inclination

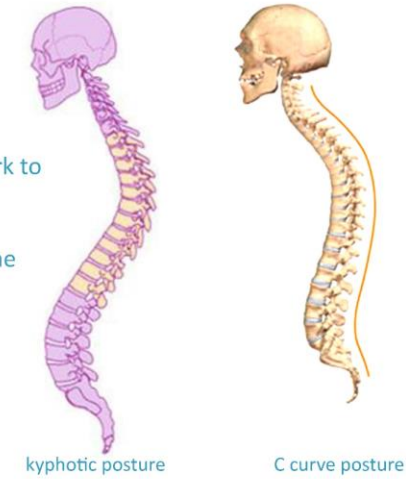
Wheelchair users tend to do a lot of functional activity from a seated position. After a long time sitting This will result in postural instability, and the user will respond by leaning forward on the seat into a slouched posture. It causes the back pain. (Image 10)



Vibrations and jerks

When the foot rest hits door thresholds when traversing .It gives a sudden jerk to the whole body.(Image 11)

The vibrations which are generated While using ramp creates unstability to the whole body posture.It happens on the rough terrain.(Image12)



kyphotic posture

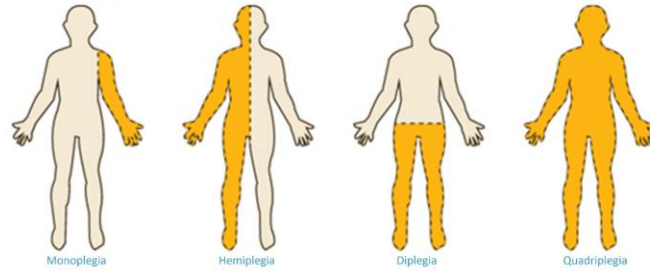
C curve posture

stretching of muscles is caused by the sudden jerks and vibrations which creates stress to the users having the kyphotic posture and C curve posture.

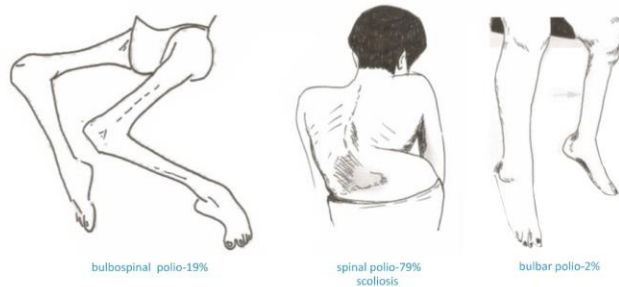




Cerebral palsy



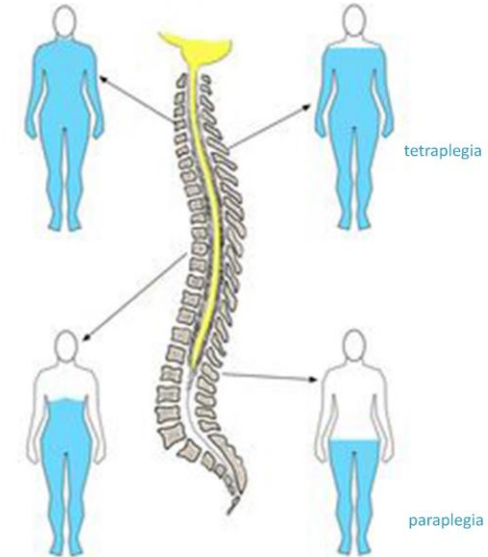
Poliomyelitis(Paralytic)



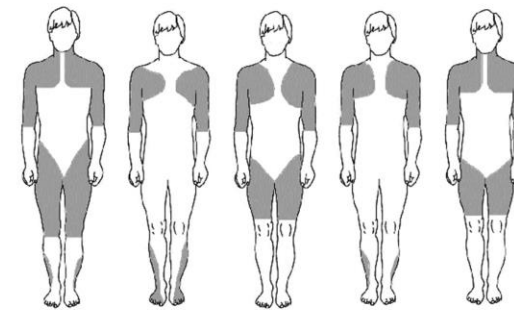
Lower limb amputation (bilateral)



Paraplegia/Tetraplegia



Muscular dystrophy

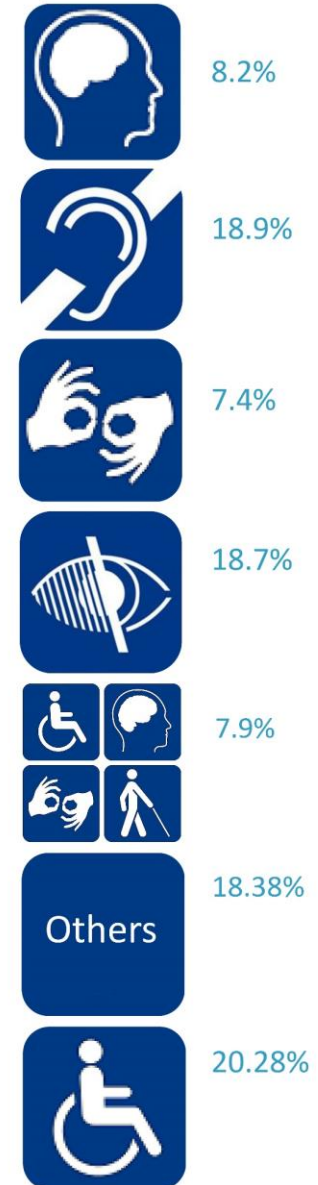


main areas of muscle weakness in different types of dystrophy





Source: Census 2011





Poliomyelitis(Paralytic)



bulbospinal polio-19%

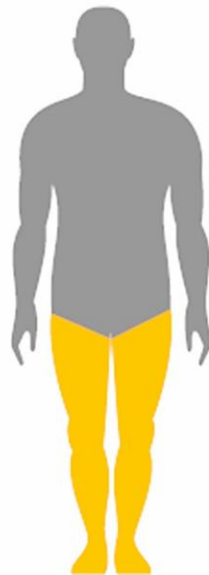


spinal polio-79%
scoliosis



bulbar polio-2%

Lower limb amputation (bilateral)

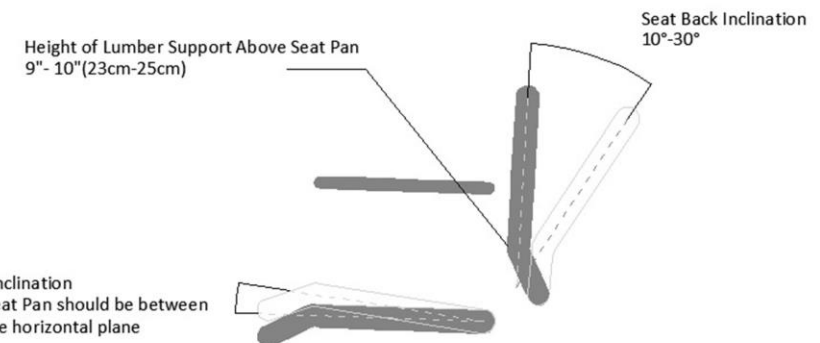
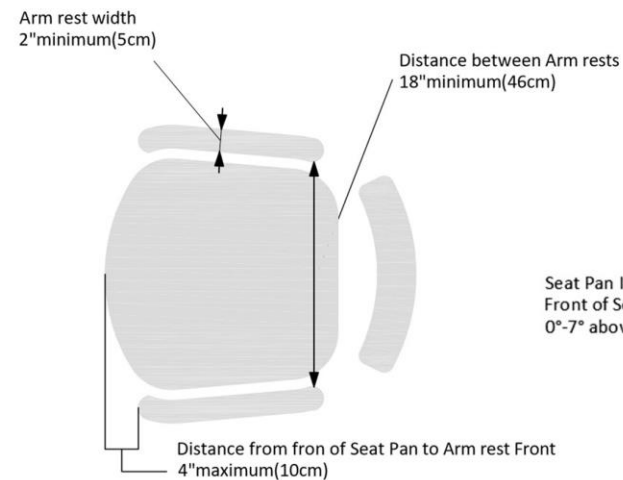
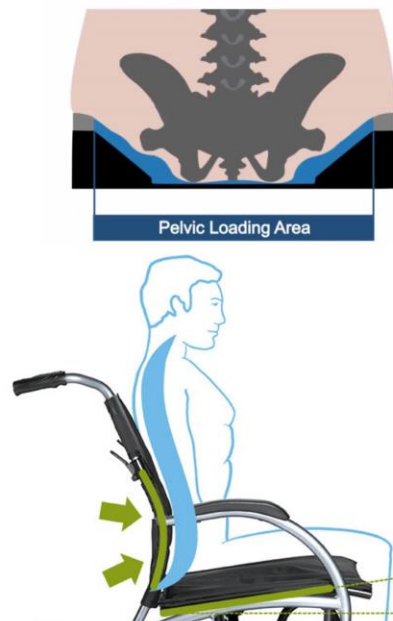
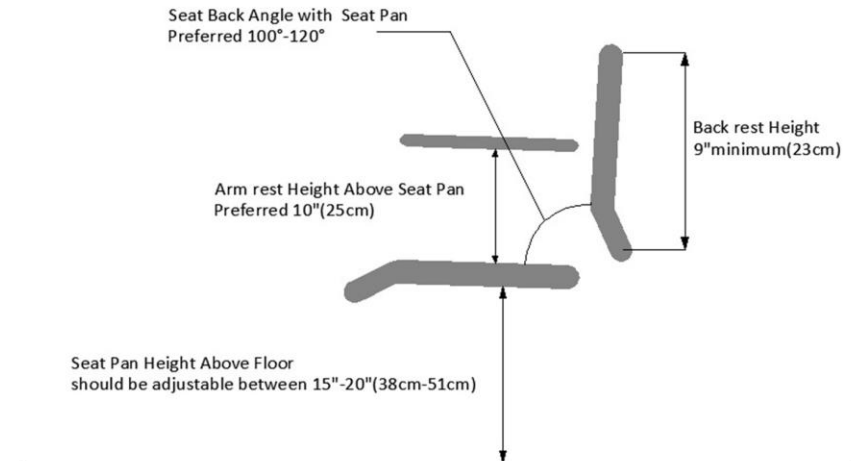
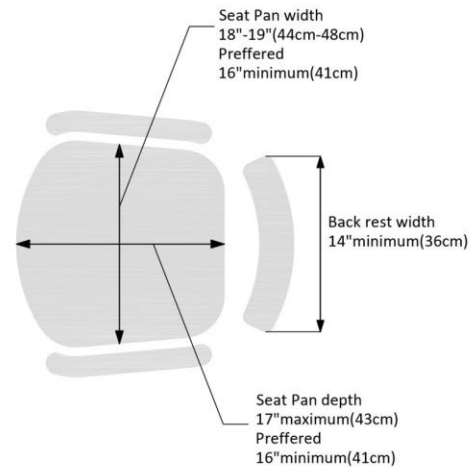


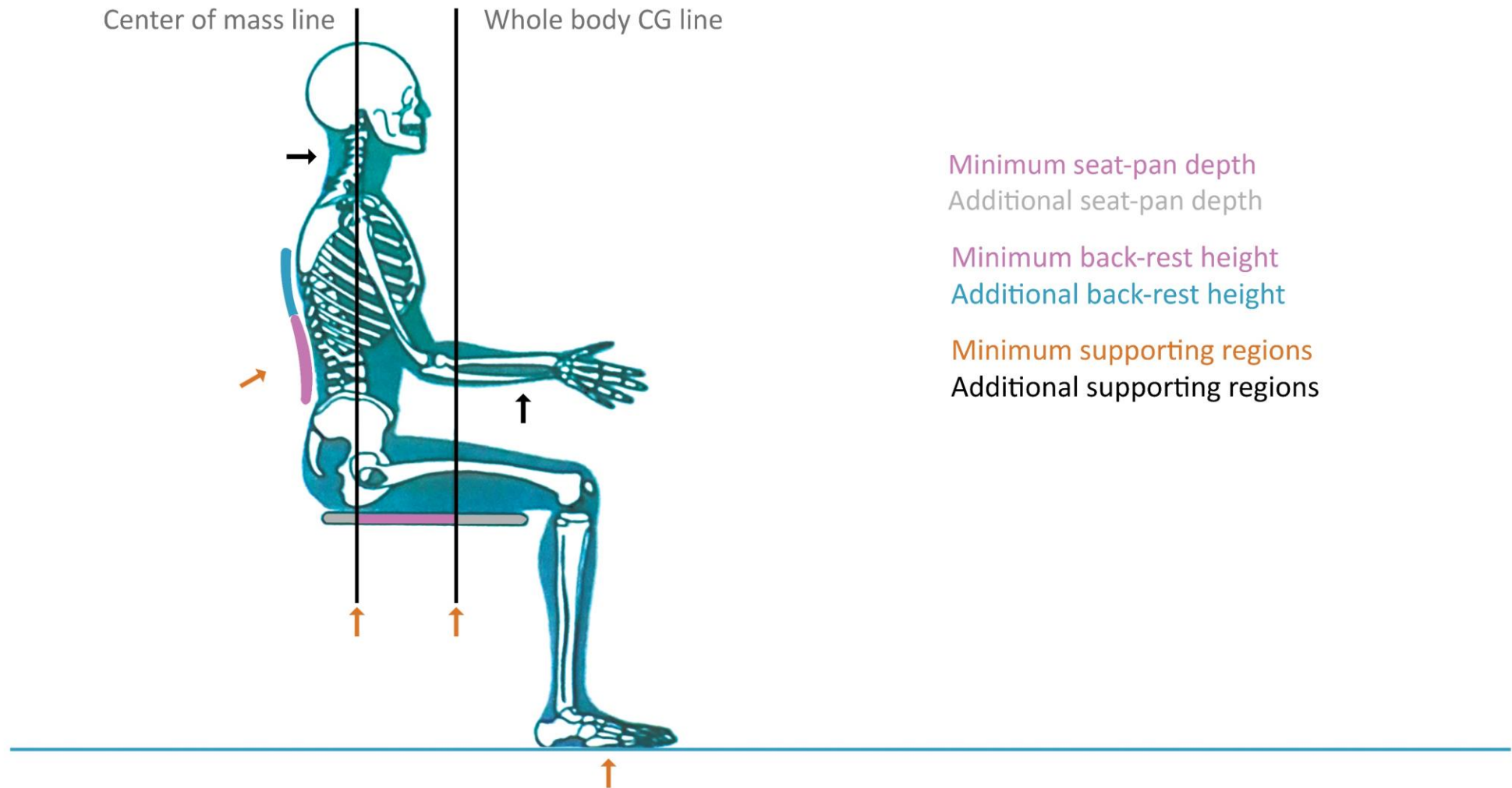
Elderly people

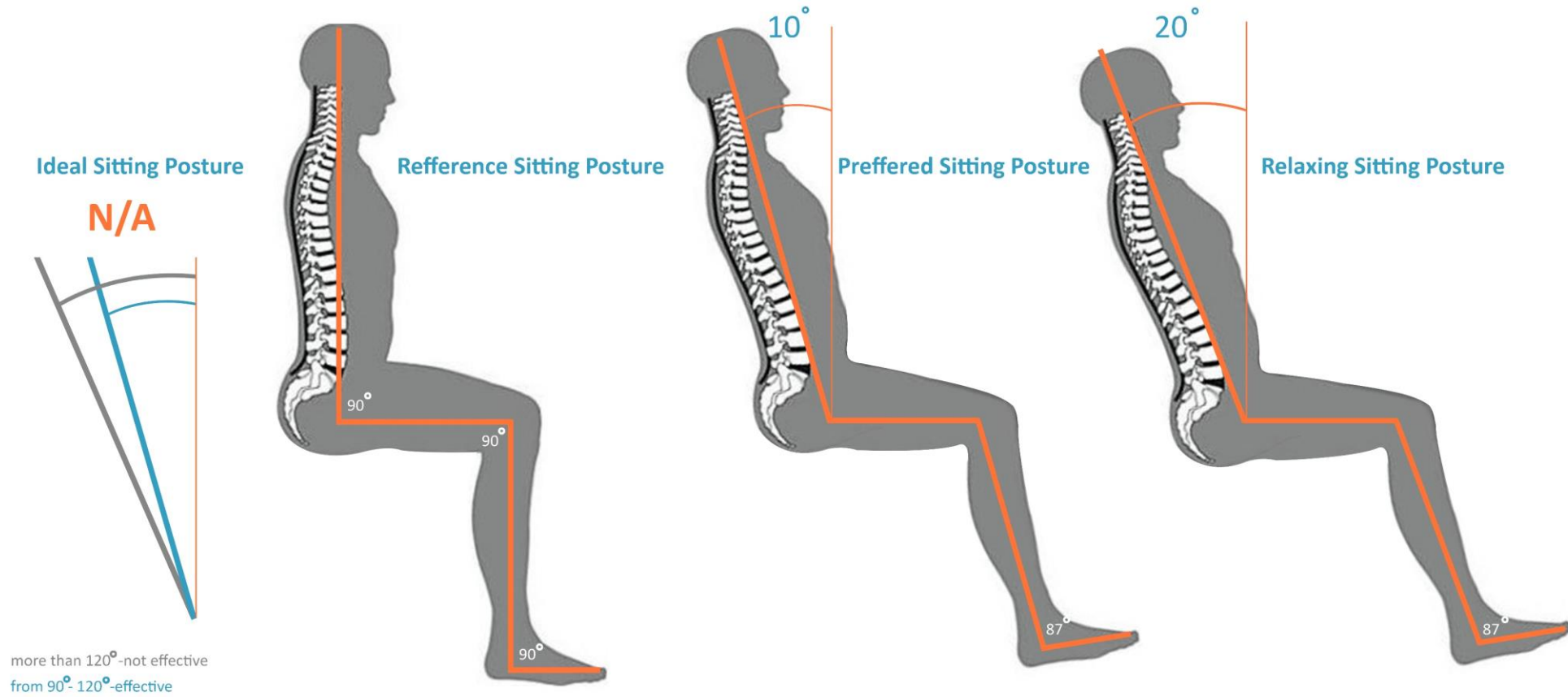




Selected Structural Body Dimensions (cm)		
Body Features	95 Percentile Male	5 Percentile Female
Height	185	150
Sitting Height, erect	97	79
Sitting Height, normal	93	75
Knee Height	59	46
Elbow-Rest Height	49	36
Thigh-Clearance Height	30	18
Buttock-Knee Length	18	10
Buttock-Knee Length	64	52
Buttock-Popliteal Length	55	43
Elbow to Elbow Width	51	31
Seat Width	40	31









To redesign a lightweight wheelchair (Weight reduced by 30%) so that it can enhance the comfort level of users in day to day life activity with the ease in manoeuvrability. Following points are also taken forward for the user-cantered design:

Foldability-Reduced volume after folding
Portability-Easy Transportation

The challenge lies in making the innovation scalable on a mass manufacturing level.

This is because of the increase in NGOs requirement of low production cost of wheelchairs for their strategic **CSR initiatives**.



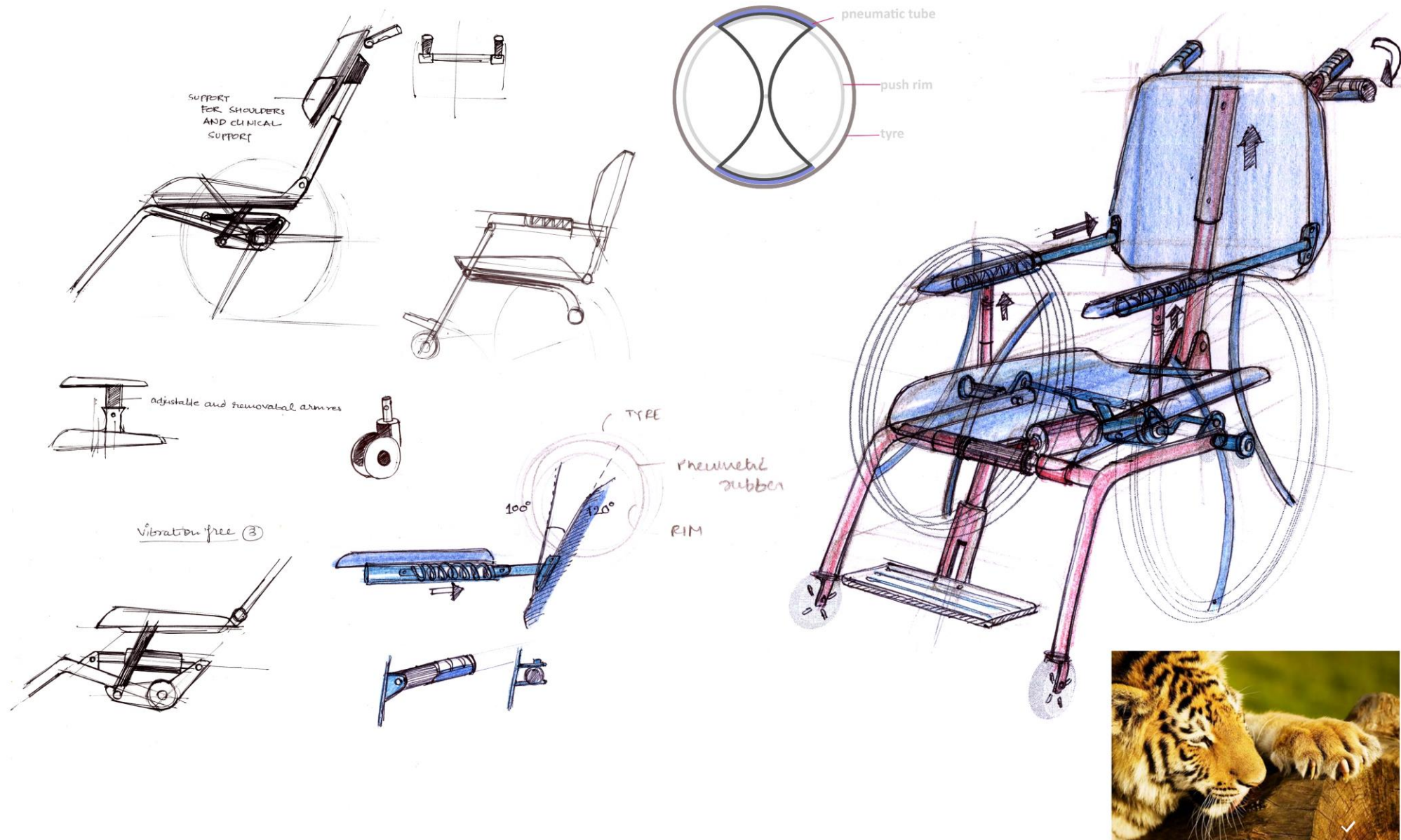
After studying the inspirations Following are the keywords for explorations for the best user-centered design of wheelchair.

TOUGH
PORTABLE
RESILIENT



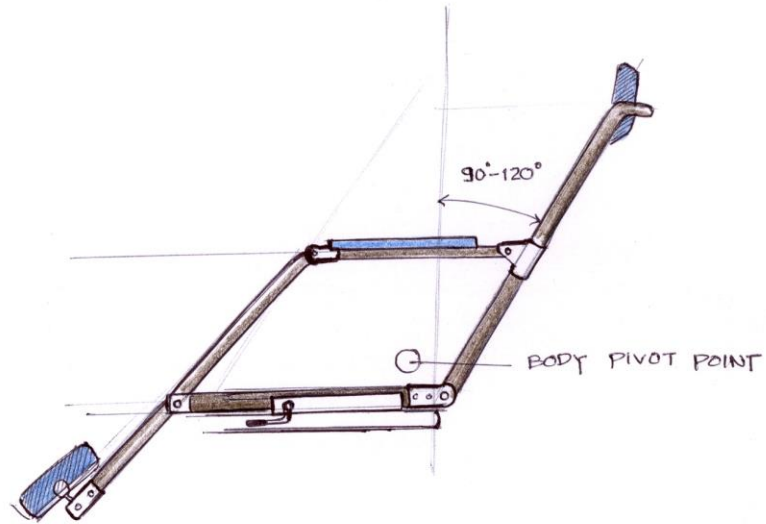
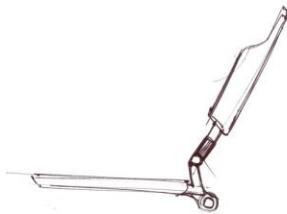
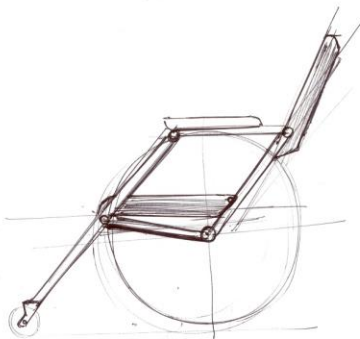
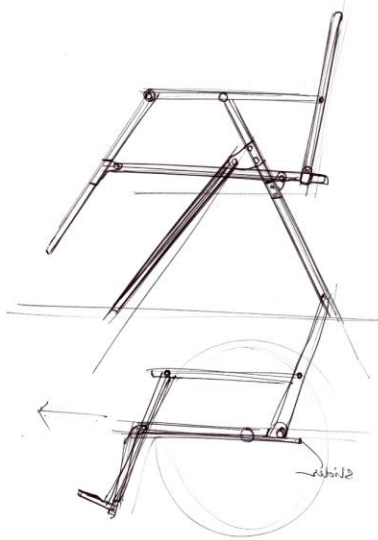


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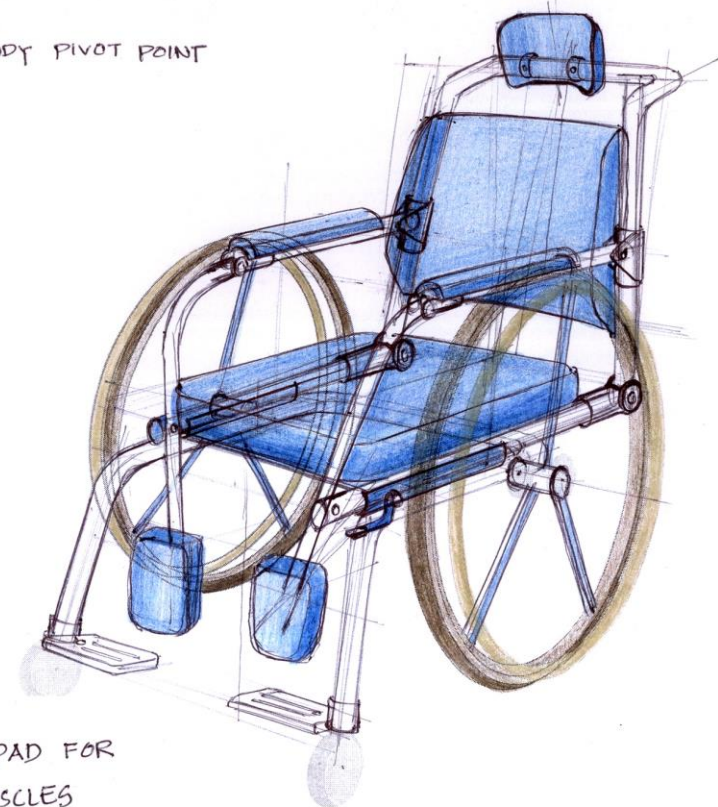




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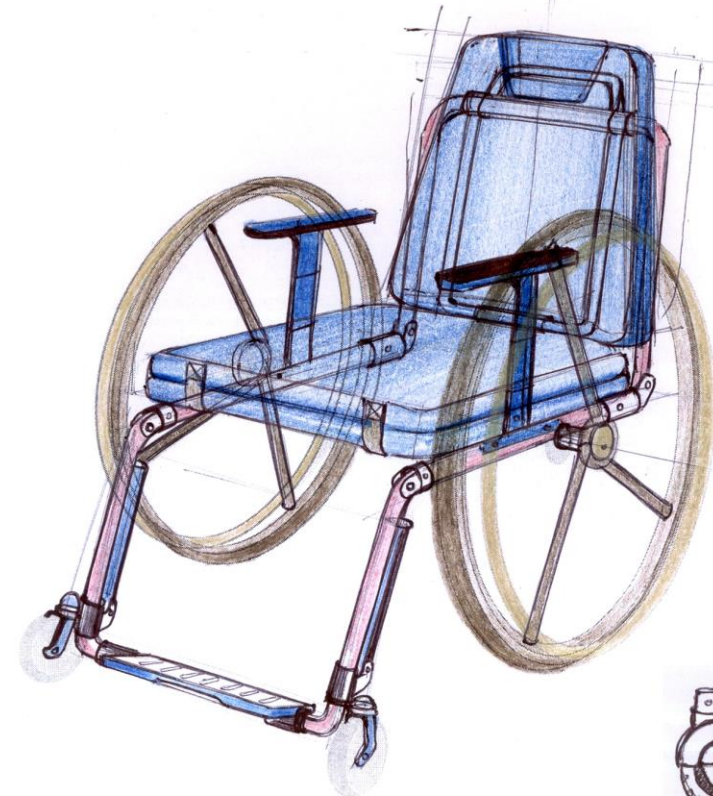
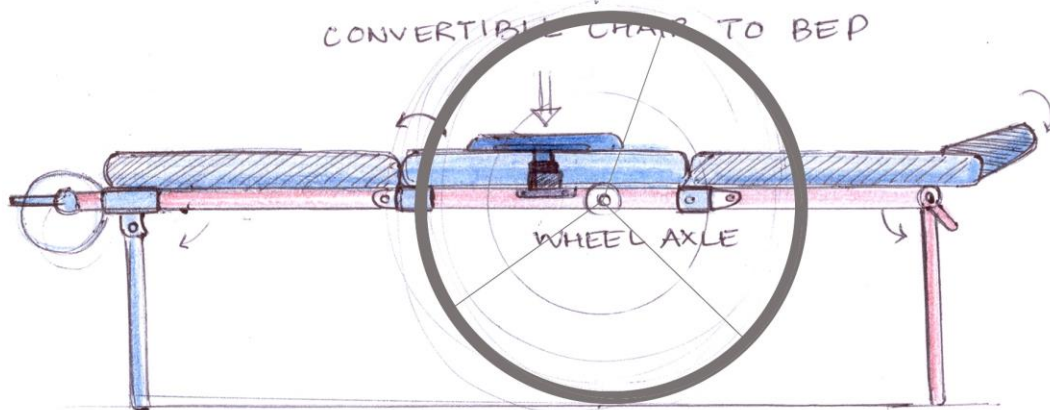
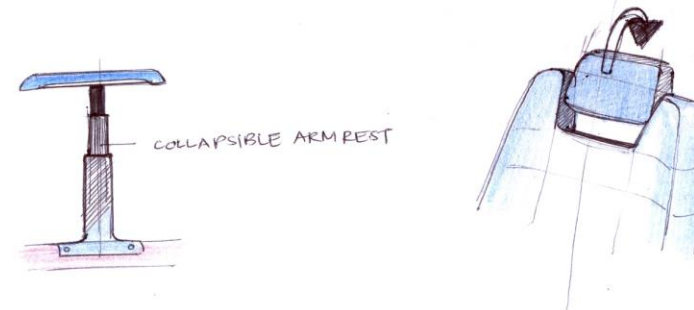


SWIVEL PAD FOR
CALF MUSCLES



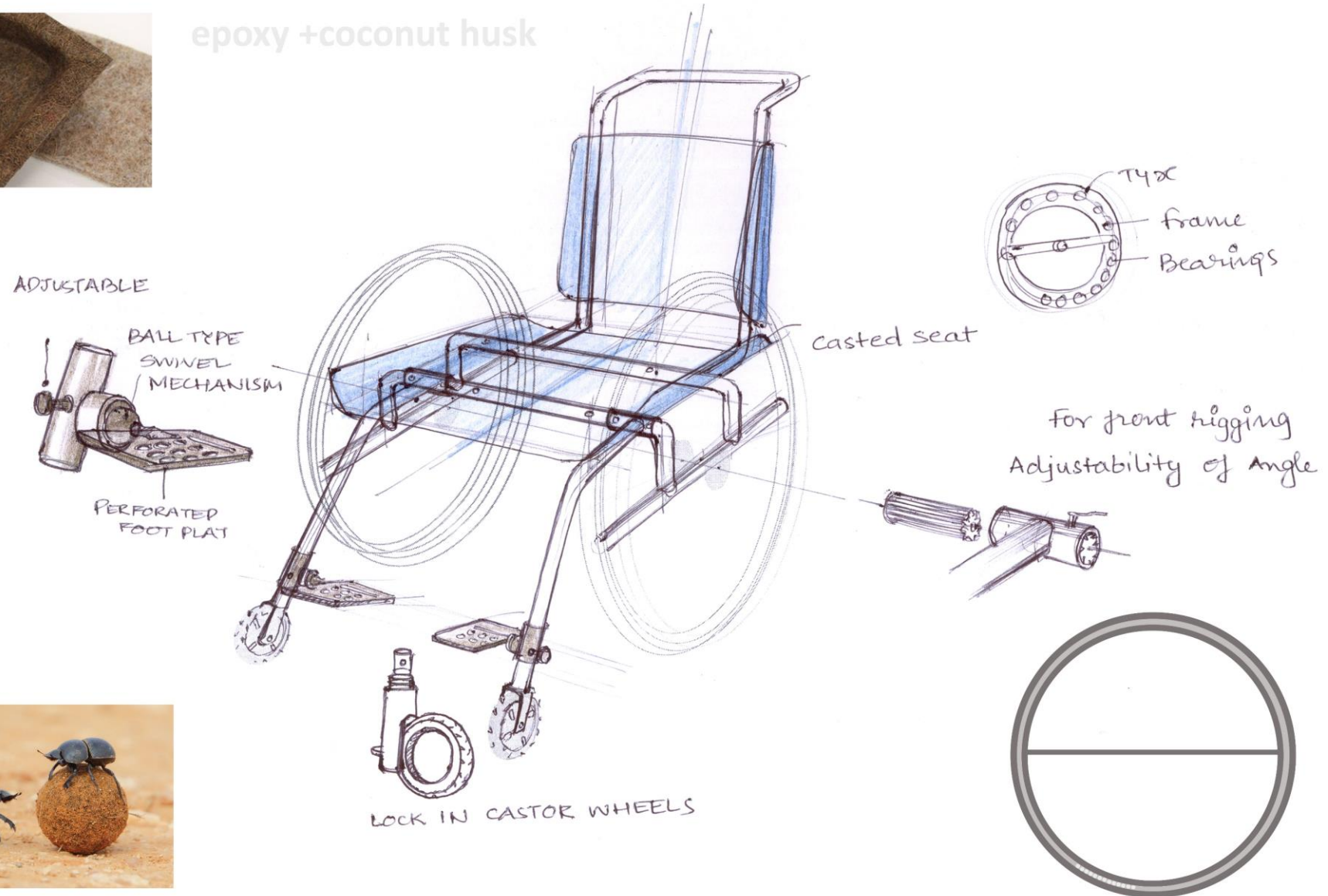


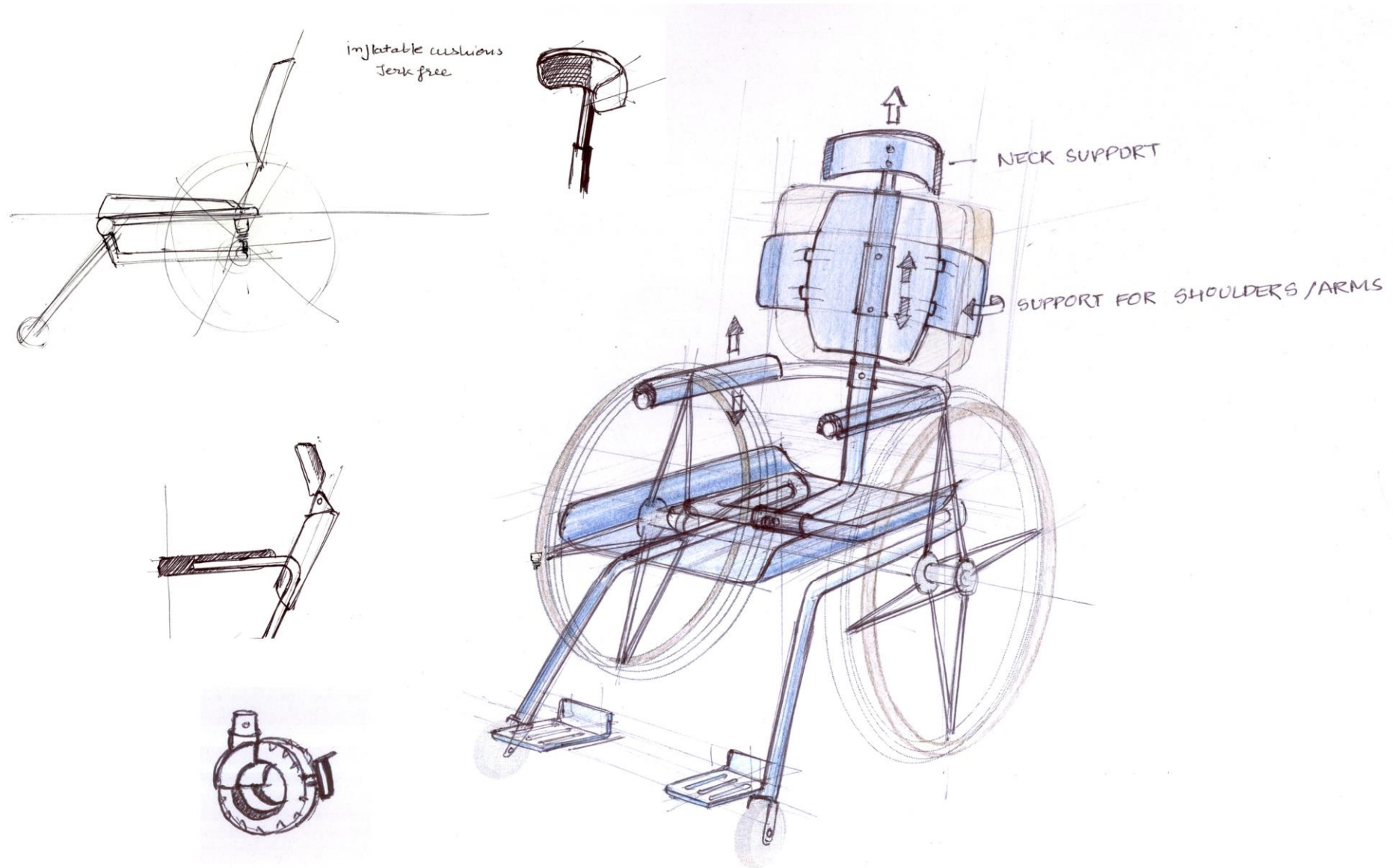
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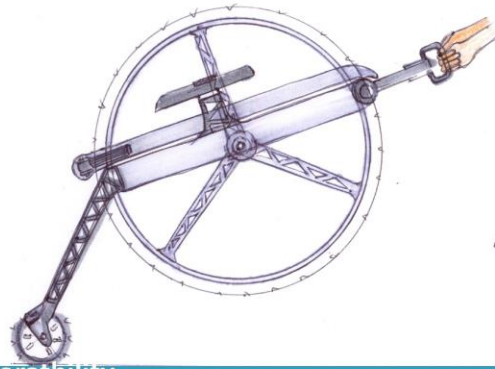
convertible bed



epoxy +coconut husk

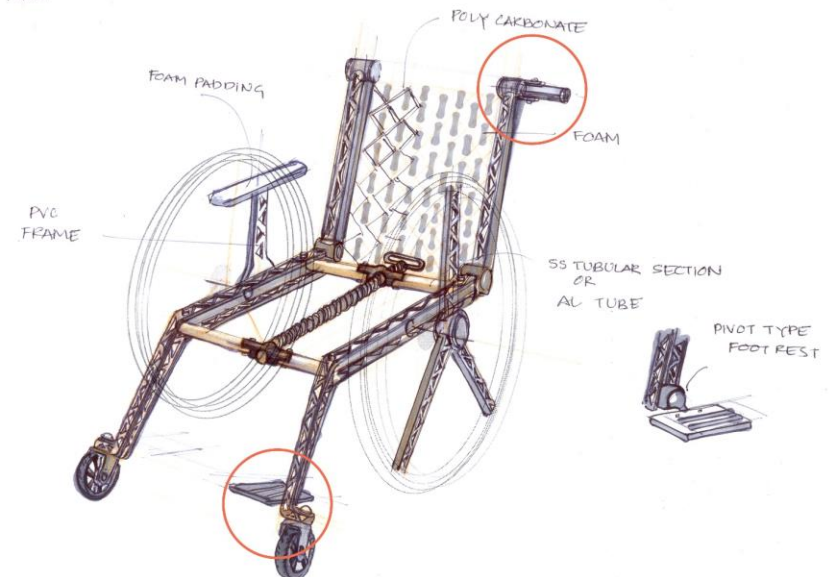
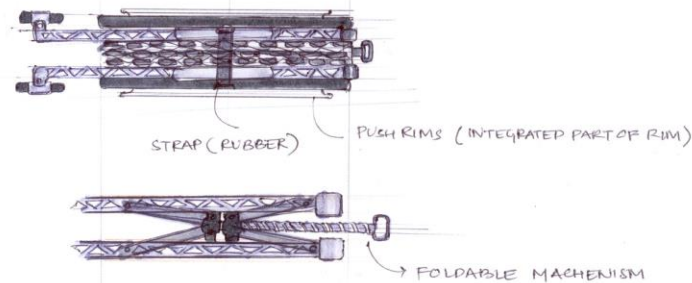
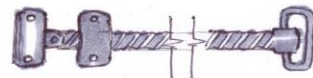
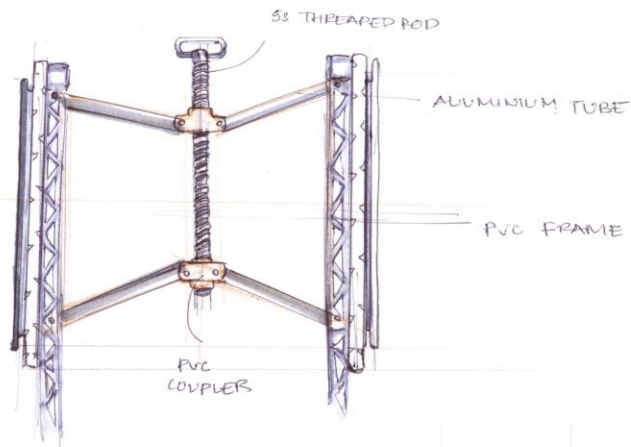
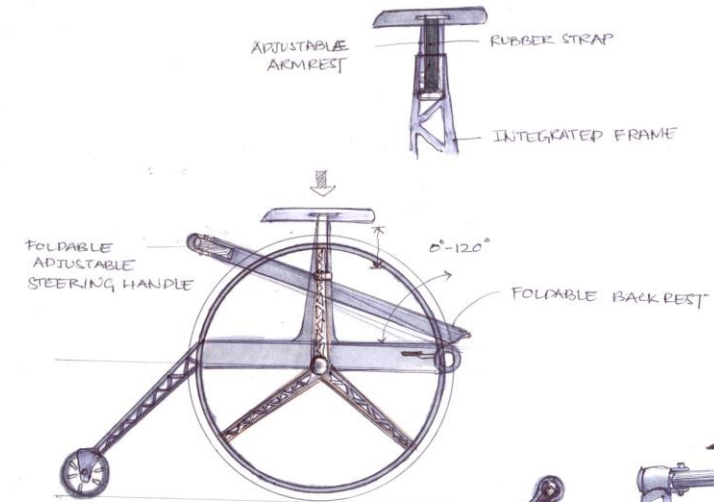
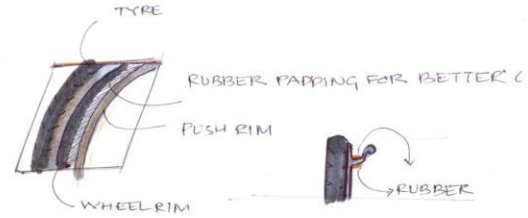


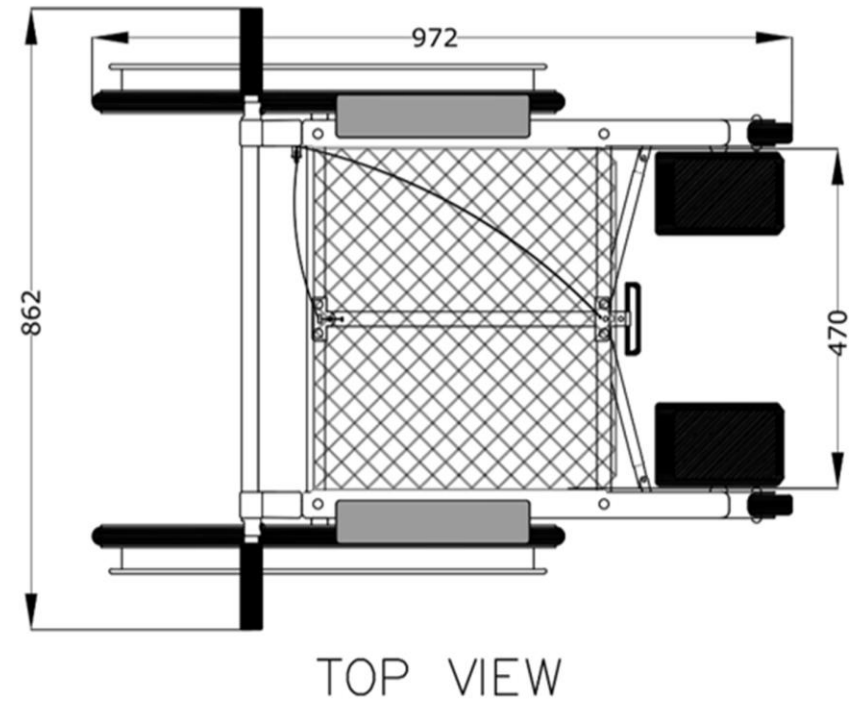
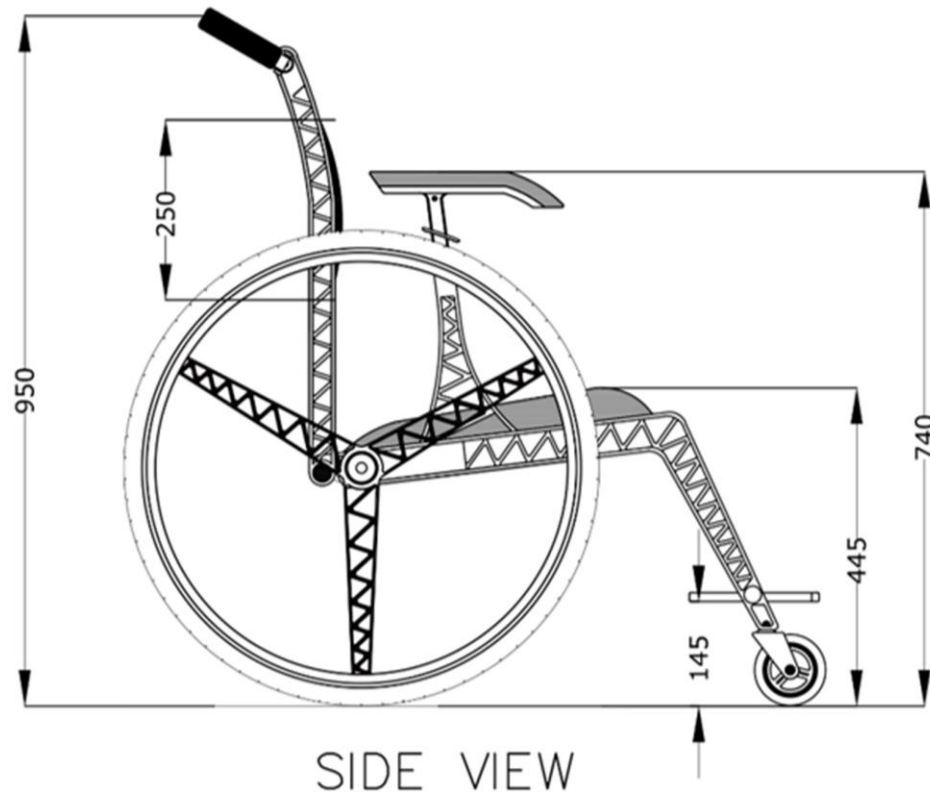


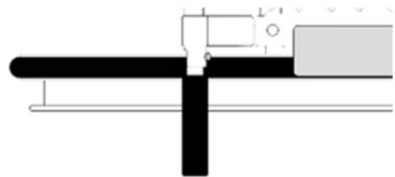


transportability

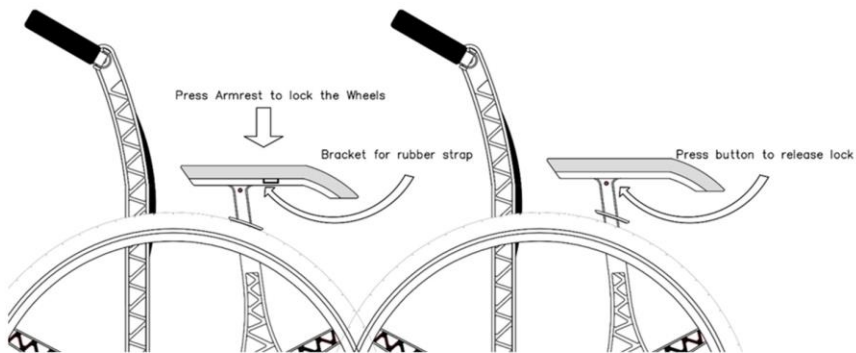
foldability







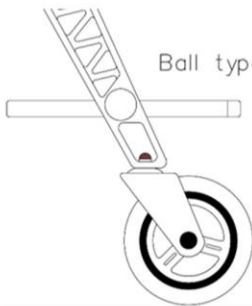
Adjustable Steering Bar



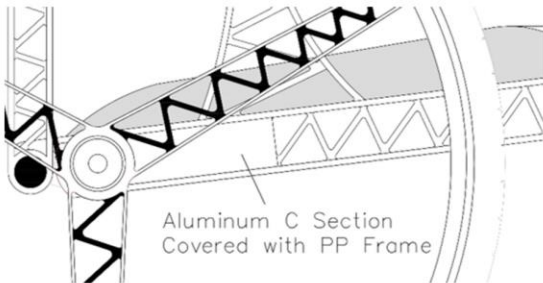
Press Armrest to lock the Wheels

Bracket for rubber strap

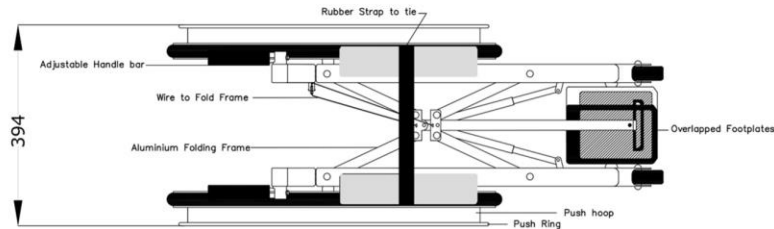
Press button to release lock



Ball type pivot(swivel typefoot plate)



Aluminum C Section Covered with PP Frame



394

Rubber Strap to tie

Adjustable Handle bar

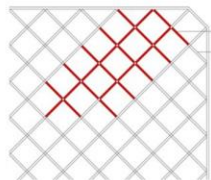
Wire to Fold Frame

Aluminium Folding Frame

Overlapped Footplates

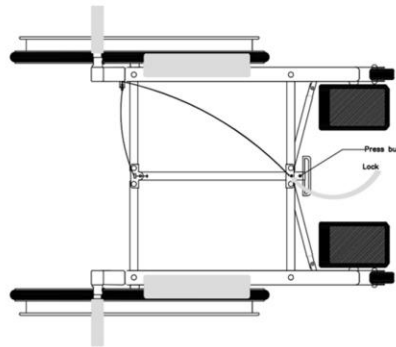
Push hoop

Push Ring



Foam Lining

Polycarbonate foldable structure



Press button to fold the Wheelchair

Lock

